

## Effect of physiotherapy on respiratory functions in patients with chronic neck pain

Physiotherapy on respiratory functions of neck pain

Tomris Duymaz

Department of Physiotherapy and Rehabilitation, Health Science Faculty, Istanbul Bilgi University, Istanbul, Turkey

### Abstract

**Aim:** The aim of this study was to investigate the effects of physiotherapy methods applied for chronic neck pain treatment on pulmonary function, functional capacity, pain, and disability. **Material and Method:** This is a randomized controlled prospective study conducted in 84 patients with chronic neck pain. Patients were divided into 2 groups and physiotherapy was performed in 42 patients (10 minutes with ultrasound 1.0W/cm<sup>2</sup> intensity, 20 minutes with conventional Transcutaneous Electrical Nerve Stimulation, 20 minutes with hot pack), home exercise program, respiratory exercises; and 42 patients in the control group had only home exercise and breathing exercises. Age, body mass index (BMI), duration of pain, severity and frequency of pain were recorded in all patients before treatment. Then, at the beginning and at the end of the treatment, pain intensity was assessed by visual analog scale (activity, rest, night), functional capacities with 6-minute walking test (6MWT), respiratory function tests with a spirometer, and disability with neck disability index (NDI) were assessed. Statistical analysis was performed with SPSS 22.0 program and  $p < 0.05$  was considered significant. **Results:** The mean age of the patients was  $42.40 \pm 7.26$  years and mean pain duration was  $18.47 \pm 13.49$  months. VAS, 6MWT, NDI and VC, ERV (expiratory reserve volume), TV (tidal volume), FEV<sub>1</sub> (forced expiratory volume in 1 second), FEV<sub>1</sub> / FVC, FEF<sub>25-75</sub> (forced expiratory flow at 25-75%) were found to have a significant improvement in the treatment group in intra- and intergroup comparisons ( $p < 0.001, p < 0.001, p < 0.001, p < 0.001, p < 0.001, 0.024, 0.057, p < 0.001, 0.009, p < 0.001, 0.006$ ). In the control group, the only significant improvement was observed in intra-group VAS values,  $p = 0.015, 0.020, 0.034$ ). **Discussion:** Physiotherapy program applied to patients with chronic neck pain has been found to increase respiratory functions and functional capacity with decreasing pain and disability level.

### Keywords

Chronic Neck Pain; Physiotherapy; Respiratory Functions

DOI: 10.4328/ACAM.6123 Received: 13.12.2018 Accepted: 17.01.2019 Published Online: 22.01.2019 Printed: 01.11.2019 Ann Clin Anal Med 2019;10(6): 724-7  
Corresponding Author: Tomris Duymaz, Department of Physiotherapy and Rehabilitation, Health Science Faculty, Istanbul Bilgi University, Istanbul, Turkey.  
GSM: +905446302676 E-Mail: tomrisduymaz@gmail.com  
ORCID ID: <https://orcid.org/0000-0003-0917-2098>

## Introduction

Chronic neck pain is the second most common musculoskeletal problems in the population. Chronic neck pain is one of the most common musculoskeletal complaints that cause motor control changes in the cervical region and related structures [1]. Neck pain is a musculoskeletal disorder, which occurs in about 23% of the general population, but causes disability and cost increase day by day. Although there are periodic remission and exacerbation periods, most of the patients have a chronic condition in which their symptoms are not completely healed. In some studies, it has been reported that activation of superficial cervical muscles, increase of forward head posture, and restriction of neck spinal mobility is seen with various dysfunctions, sensorimotor disorders, and deep cervical flexor muscles inhibition due to chronic neck pain [2]. In recent years, studies have reported that chronic neck pain causes deterioration of respiratory functions such as maximal inspiration and reduction of expiratory pressures. When looking at pulmonary capacities, it is seen that all voluntary ventilation volumes, especially the inspiratory reserve, are decreasing. Factors leading to respiratory dysfunction in patients with chronic neck pain are listed as follows: 1) Weakness of deep neck flexor and extensor muscles, reduction of cervical thoracic spinal stability due to changes in rib cage mechanics, 2) Variation of the force-length curve due to hyperactivity of the sternocleidomastoid muscle and restriction of the range of motion of the cervical spine, 3) Chronic pain and kinesiophobia chronic hyperventilation and change of arterial blood values [3,4].

Respiratory exercises given in the treatment of patients with chronic neck pain are reported to decrease pulmonary capacity and disability level [5]. However, in the literature review, there was no study investigating the effect of physiotherapy methods on respiratory functions as well as respiratory exercises in the neck region. In this sense, this study is the first.

The aim of this study is to investigate the efficacy of physiotherapy methods applied to patients with chronic neck pain, on respiratory functions, functional capacity, disability level, and pain severity.

## Material and Method

**Participants:** This is a prospective, randomized controlled trial of 84 patients with chronic neck pain diagnosed at the XXX Hospital Physical Therapy and Rehabilitation Department. The inclusion criteria included patients aged between 30 and 50 years who had complain of pain at least once a week with neck pain for the last 6 months. Written informed consent was obtained from patients who participated in this study. Exclusion criteria included smoking, traumatic neck pain, obese patients (body mass index >40), spinal fractures or surgery patients, the presence of inflammatory pathology in the cervical region, presence of severe comorbidity (musculoskeletal, neurological, cardiorespiratory, neuromuscular) diabetes mellitus, pregnancy. Ethics committee approval for the study was obtained from the XXX University Ethics Committee for Clinical Researches (Approval number: 2018-40016-95). Patients were randomly divided into 2 groups of 42 people. A randomized list is prepared in a computer environment by a statistician for randomization.

In this list, the odd numbers for the control group and the physiotherapy group were given double numbers. The group identification is printed on sequentially numbered cards placed in sealed envelopes. After enrollment, the numbered envelope was opened by the patient and the blind investigator.

**Interventions:** While in the treatment group physiotherapy, home exercises and respiratory exercises were performed, the patients in the control group had only home exercise and respiratory exercises. In the physiotherapy program, every session patients were treated with Ultrasound for 10 minutes at 1.0W/cm<sup>2</sup>, conventional Transcutaneous Electrical Nerve Stimulation (TENS) for 20 minutes, and a hot pack for 20 minutes. Sessions were applied in 20 sessions for a total of 5 days per week for 4 weeks. The home exercise program was designed to teach joint movements in the direction of neck flexion, extension, lateral flexion and isometric exercises in the same directions. Breathing, diaphragm, and lips breathing have been taught as breathing exercises. All patients were asked to repeat the exercises 10 times a day 3 times a day.

**Outcome measurements:** Age, body mass index (BMI), duration of pain, severity, and frequency of pain were recorded in all patients before the treatment. Then, at the beginning and at the end of the treatment, pain intensity was assessed by visual analog scale (activity, rest, and night), functional capacities with 6-minute walking test, respiratory function tests with a spirometer (Cosmed Pony FX), and disability with neck disability index were assessed.

**Visual Analog Scale (VAS):** The VAS pain score was measured to determine the pain level of the patients. The 0-10 cm chart was presented to the patient, with 0 no pain, 0 the most severe pain felt in life 10, 18 and was asked to mark the pain severity. Then the point marked with the millimetric ruler was measured and recorded [6].

**Six-minute walking test (6MWT):** Functional exercise capacity was evaluated using a six-minute walking test. The subjects were instructed to walk as far as possible in six minutes in an enclosed 50-m long hospital corridor. Standardized encouragement was given in every 30 s. The maximum distance covered at the end of the test was recorded [7].

**Neck disability index (NDI):** The Neck Disability Index is a functional assessment form developed by Howard Vernon [8], whose Turkish validity and reliability study was also conducted by Kesiktaş et al. in 2012 [9]. The questions investigated the severity of neck pain and the relationship of pain to occupational life, recreational activities, social and functional impact on life, and emotional factors. Each question is scored between 0 and 5. The total score gives the test score. According to the test result, there is no disability between 0-4 points, mild disability between 5-14 points, moderate disability between 15-24 points, severe disability between 25-34 points, completely disability 35 points and above.

## Statistical analysis

All the statistical analyses were performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA). Continuous and categorical data are reported as mean ± standard deviation and number (percentages), respectively. The Kolmogorov-Smirnov test was performed to determine the suitability of the data for normal

distribution. The Mann Whitney-U, Wilcoxon and Friedman K tests were used to compare the variables between the intra- and inter groups. P value < 0.05 was accepted as meaningful for all statistical levels.

Table 1. Demographic characteristics of patients

	Physiotherapy group (n=42) Mean±SD	Control group (n=42) Mean±SD	z	p
Age (year)	41.57±8.02	43.46±6.17	-0.442	0.658
BMI (kg/m²)	22.75±3.66	22.66±1.96	-2.43	0.808

Mann-Whitney U Test. BMI: Body Mass Index, SD: Standard deviation.

Table 2. Comparison of inter-group and intragroup respiratory function tests

RFT Static Values	Physiotherapy group Mean±SD	Control group Mean±SD	z	p
VC Pre-T	3.95±1.10	4.40±1.06	-1.197	0.231
VC Post-T	5.40±0.59	4.60±0.84	-2.259	0.024*
z	-2.900	-1.647		
p	0.004**	0.099		
ERV Pre-T	1.04±1.04	1.12±1.02	-0.544	0.586
ERV Post-T	1.63±0.17	1.48±0.15	-1.907	0.057
z	-2.271	-1.334		
p	0.023*	0.182		
IRV Pre-T	2.40±1.23	2.67±1.10	-0.680	0.496
IRV Post-T	2.69±1.08	1.97±0.79	-1.247	0.213
z	-0.459	-1.540		
p	0.646	0.123		
TV Pre-T	0.50±0.25	0.49±0.23	-0.218	0.828
TV Post-T	2.05±1.12	0.49±0.26	-3.376	<0.001**
z	-2.803	0.000		
p	0.005*	1.000		
Dinamic Values				
FEV1 Pre-T	3.25±0.78	3.66±0.83	-1.360	0.174
FEV1 Post-T	3.32±0.38	3.85±0.55	-2.615	0.009**
z	-0.175	-1.117		
p	0.861	0.239		
FEV1/FVC Pre-T	88.38±7.24	86.50±8.59	-0.545	0.586
FEV1/FVC Post-T	75.00±1.91	83.50±0.52	-4.323	<0.001**
z	-3.181	-1.693		
p	<0.001**	0.091		
PEF (L/sn) Pre-T	6.19±2.41	5.44±1.87	-0.653	0.514
PEF (L/sn) Post-T	9.14±1.13	8.59±1.36	-0.791	0.429
z	-2.970	-3.059		
p	0.003*	0.002*		
FEF25-75(L/sn) Pre-T	3.86±1.26	3.91±1.18	-0.218	0.828
FEF25-75(L/sn) Post-T	5.27±0.52	4.59±0.46	-2.775	0.006**
z	-2.551	-2.118		
p	0.011*	0.034*		

\*p<0.05, \*\*p<0.001. Mann-Whitney U Test; Wilcoxon Test. RFT: Respiratory function test, VC: vital capacity, IRV: inspiratory reserve volume, ERV: expiratory reserve volume, TV: tidal volume, FEV1: forced expiratory volume in 1 second, FVC: forced vital capacity, PEF: peak expiratory flow, FEF25-75: forced expiratory flow at 25-75%, L/sn: liters / second; T: treatment. SD: Standard deviation.

Results

The mean age of the patients participating in the study was 42.40±7.26 years, the mean BMI was 22.71±2.91kg/m² and mean pain duration was 18.47±13.49 months (Table 1); 50.9% of the patients reported that their pain was moderate. There is a significant improvement in VAS (activity, rest, and night), 6MWT, VC (vital capacity), ERV (expiratory reserve volume), TV (tidal volume), FEV1 (forced expiratory volume in 1 second), FEV1/FVC, FEF25-75 (forced expiratory flow at 25-75%) compared between the groups and intra-groups before and after the treatment (p<0.001, p<0.001, p<0.001, p<0.001, 0.024, 0.057, p<0.001, 0.009, p<0.001, 0.006) (Table 2). In the control group, significant improvement was observed only in the treatment group pain assessment (VAS night, activity, rest) (p=0,015;0,020;0,034) (Table 3).

While moderate disability was determined in all patients before the treatment according to NDI, a significant improvement was observed in the physiotherapy group after the treatment and moderate disability was observed in patients in the control group with disability (p<0.001, 0.257) (Table 3).

Discussion

This research is the first to investigate the efficacy of physiotherapy methods applied to the neck region to improve the reduced respiratory function of patients with chronic neck pain. As a result of this study, physiotherapy methods applied to the patients with chronic neck pain were found to increase respiratory functions and functional capacity by decreasing pain severity and disability level.

Table 3. Comparison of inter-group and intragroup pain, functional capacity and disability

	Physiotherapy group Mean±SD	Control group Mean±SD	z	p
VAS night Pre-T	3.92±2.58	4.92±3.14	-0.879	0.380
VAS night Post-T	0.42±0.75	4.15±2.60	-3.522	<0.001**
z	-3.193	-2.428		
p	<0.001**	0.015*		
VAS activity Pre-T	5.21±2.15	6.23±2.42	-1.182	0.237
VAS activity Post-T	0.57±0.75	5.69±2.13	-4.299	<0.001**
z	-3.321	-2.333		
p	<0.001**	0.020*		
VAS rest Pre-T	4.14±1.87	4.61±2.69	-0.620	0.536
VAS rest Post-T	0.35±0.63	4.15±2.23	-3.719	<0.001**
z	-3.210	-2.121		
p	<0.001**	0.034*		
6MWT Pre-T	447.85±178.24	555.38±141.98	-1.582	0.114
6MWT Post-T	754.00±112.72	554.23±138.20	-3.402	<0.001**
z	-3.297	-0.317		
p	<0.001**	0.751		
NDI Pre-T	11.50±6.03	10.00±7.78	-0.754	0.451
NDI Post-T	0.78±0.89	9.76±7.39	-4.137	<0.001**
z	-3.297	-1.134		
p	<0.001**	0.257		

\*p<0.05, \*\*p<0.001. Mann-Whitney U Test,Wilcoxon Test. VAS: Visual analog scale, 6MWT: Six minute walk test, NDI: Neck disability index. T: Treatment. SD: Standard deviation.

Recent studies have emphasized the effect of neck pain and neck mechanical disturbances on respiratory functions. It has been reported that patients with neck pain may have impaired disability and respiratory functions in clinically significant [10]. In the study of Dimitriadis et al., maximal inspiratory and expiratory pressures of patients with mild chronic neck pain were reported to be reduced according to the NDI [11]. Evans and Whitelaw reported that patients with chronic neck pain had a 5.5% reduction in maximal inspiration and a 4.1% decrease in maximal expiration [12].

The comparison of pulmonary volumes between persons with and without chronic neck pain was performed in only 4 studies. Among these studies, it was reported that FVC in one, FEF in two, and PEF in the other two studies were affected in patients with neck pain [13]. Dimitriadis et al. found that FVC, expiratory reserve volume, and maximal voluntary ventilation of patients with neck pain and disability were significantly lower than those in the control group when compared to 45 healthy subjects with 45 chronic neck pain [14]. According to the results of this study, when compared with the control group, there was a significant improvement in the post-treatment functional recovery of patients treated with physiotherapy, 36.7% in VC, 56.73% in ERV, 75.64% in TV, 15.13% in FEV1 / FVC and 36.52% and capacities increased by 68.35%.

It has been reported that respiratory performance is reduced due to the decrease in the performance of local and general muscle groups due to the increased pain intensity in chronic neck pain patients [15]. Pain severity and disability level correlated with maximal expiratory pressure in chronic neck pain. It has been reported that patients with high levels of pain and disability have a particularly reduced performance of their expiration due to sternocleidomastoid, scaleni and trapezius muscle weakness and cervical movement limitation [16]. When the results of this study were examined, it was determined that the pain intensity of the patients decreased by 89.05% and the disability levels by 93.21% after physiotherapy.

The limitations of the study include the low number of patients, the limited age group being assessed, and the lack of assessment of cervical isometric muscle strength.

## Conclusion

In conclusion, in this study, physiotherapy methods applied in the treatment of patients with chronic neck pain were found to improve patients' respiratory functions, functional capacities, and reduce pain and disability levels. Physiotherapy methods and regular exercise program are thought to be able to work more effectively with inspiration and expiration helping muscles with decreasing spasms and pain in neck muscles and thus increase respiratory functions.

## Scientific Responsibility Statement

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

## Animal and human rights statement

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

## Funding: None

## Conflict of interest

*None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.*

## References

1. Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. *Best Pract Res Clin Rheumatol*. 2010; 24(6): 783-92.
2. Falla D, Farina D. Neuromuscular adaptation in experimental and clinical neck pain. *Journal of Electromyography and Kinesiology*. 2008; 18(2): 255-61.
3. Obayashi H, Urabe Y, Yamanaka Y, Okuma R. Effects of respiratory-muscle exercise on spinal curvature. *J Sport Rehabil*. 2012; 21(1): 63-8.
4. Tsang SM, Szeto GP, Lee RY. Normal kinematics of the neck: the interplay between the cervical and thoracic spines. *Man Ther*. 2013; 18(5): 431-7.
5. Wirth B, Amstalden M, Perk M, Boutellier U, Humphreys BK. Respiratory dysfunction in patients with chronic neck pain - influence of thoracic spine and chest mobility. *Man Ther*. 2014; 19(5): 440-4.
6. Yaray O, Akesen B, Ocaklioglu G, Aydinli U. Validation of the Turkish version of the visual analog scale spine score in patients with spinal fractures. *Acta Orthop Traumatol Turc*. 2011; 45(5): 353-8.
7. ATS statement: Guidelines for the six-minute walk test. *Am J Respir Crit Care Med*. 2002; 166: 111-7.
8. Vernon H. The Neck Disability Index: state-of-the-art, 1991-2008. *J Manipulative Physiol Ther*. 2008; 31(7): 491-502.
9. Kesiktas N, Ozcan E, Vernon H. Clinimetric properties of the Turkish translation of a modified neck disability index. *BMC Musculoskelet Disord*. 2012; 13: 25.
10. Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Respiratory weakness in patients with chronic neck pain. *Man Ther*. 2013; 18(3): 248-53.
11. Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Hypocapnia in patients with chronic neck pain: association with pain, muscle function, and psychologic states. *Am J Phys Med Rehabil Assoc Acad Physiatrists*. 2013; 92(9): 746-54.
12. Evans JA, Whitelaw WA. The assessment of maximal respiratory mouth pressures in adults. *Respiratory Care*. 2009; 54(10): 1348-59.
13. Kahlaee AH, Ghamkhar L, Arab AM. The Association Between Neck Pain and Pulmonary Function: A Systematic Review. *Am J Phys Med Rehabil*. 2017; 96(3): 203-10.
14. Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Pulmonary function of patients with chronic neck pain: a spirometry study. *Respir Care*. 2014; 59: 543-9.
15. Yeampattanaporn O, Mekhora K, Jalayondeja W, Wongsathikun J. Immediate effects of breathing re-education on respiratory function and range of motion in chronic neck pain. *J Med Assoc Thai*. 2014; 97(Suppl.7): S55-9.
16. Kapreli E, Vourazanis E, Billis E, Oldham JA, Strimpakos N. Respiratory dysfunction in chronic neck pain patients. A pilot study. *Cephalalgia*. 2009; 29(7): 701-10.

## How to cite this article:

*Duymaz T. Effect of physiotherapy on respiratory functions in patients with chronic neck pain. Ann Clin Anal Med 2019;10(6): 724-7.*